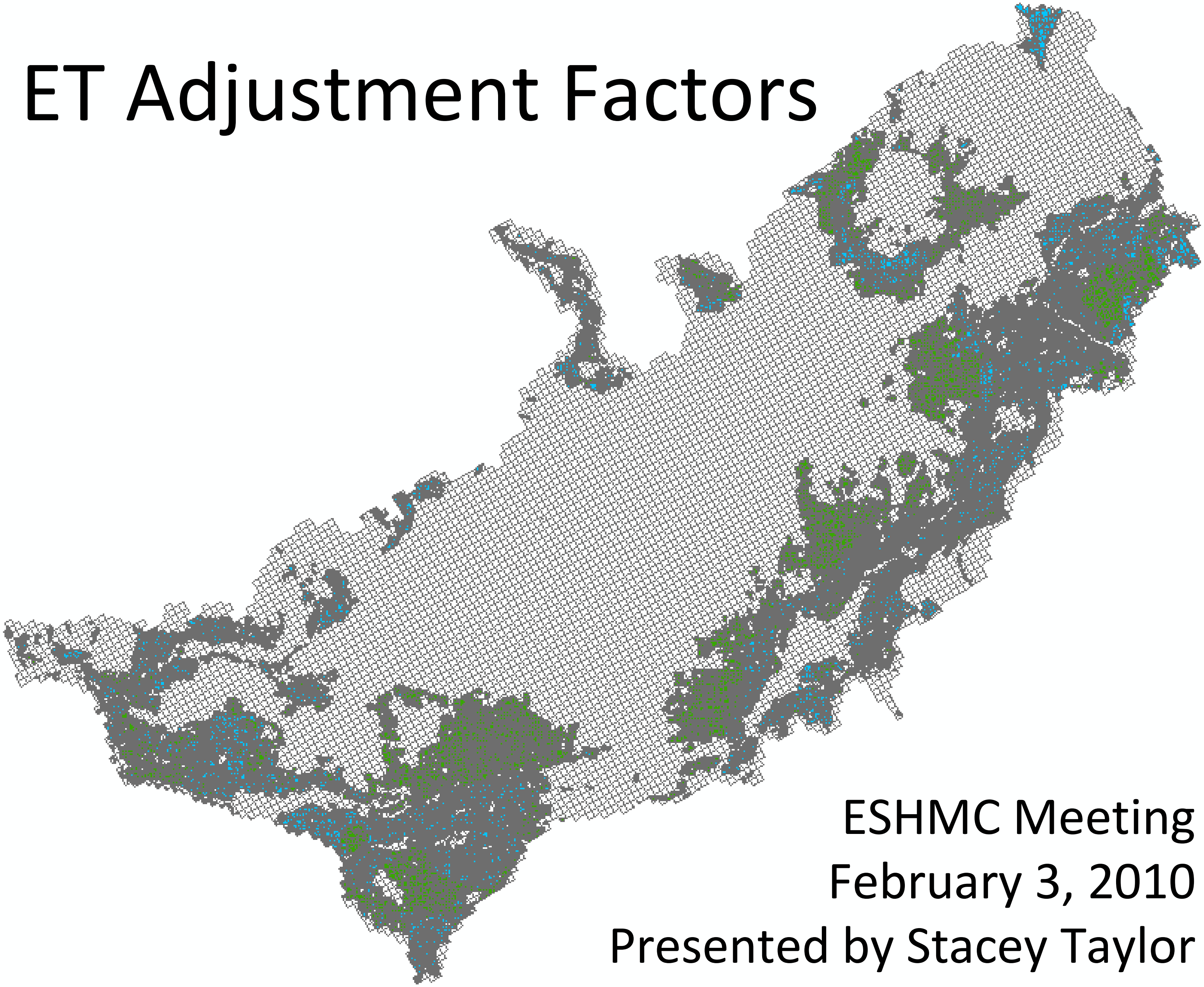
ET Adjustment Factors



ESHMC Meeting
February 3, 2010
Presented by Stacey Taylor

Overview

- Bryce wrote a memo to the ESHMC outlining the calculation and use of ET adjustment factors (dated 29 October 2009)
- Purpose: Adjust the traditional ET calculations for departures that may exist between the actual ET and traditionally-calculated ET
- A value is calculated for sprinklers and gravity irrigation

Calculation of ET

(Equation 1 from the Oct 2009 Memo)

$$ET = [(ADJ_{spr})(Area)(1-RED_{spr})(SPR) + (ADJ_{grav})(Area)(1-RED_{grav})(1-SPR)] * ET_{trad} \quad (1)$$

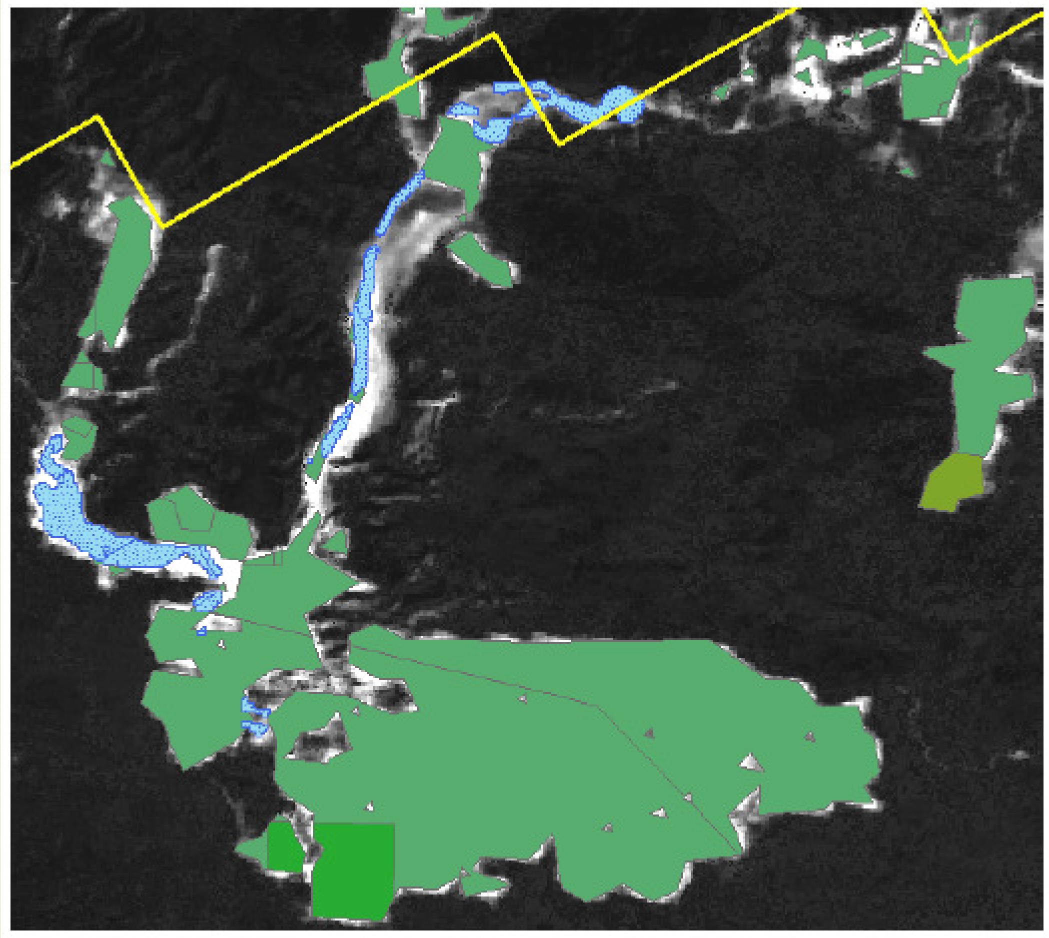
ET	= evapotranspiration volume on an individual irrigated parcel
ADJ_{spr}	= ET adjustment factor for sprinklers
$Area$	= area of parcel
RED_{spr}	= reduction for non-irrigated inclusions, sprinklers
SPR	= sprinkler fraction for entity
ADJ_{grav}	= ET adjustment factor for gravity
RED_{grav}	= reduction for non-irrigated inclusions, gravity
ET_{trad}	= depth of evapotranspiration on irrigated lands calculated by traditional methods

The recharge tool will summarize the irrigated area in each model cell by irrigation entity and will apply the equation above to irrigated area from each entity, with the appropriate ET adjustment factors and sprinkler fraction for the given entity.

Calculating Adjustment Factors

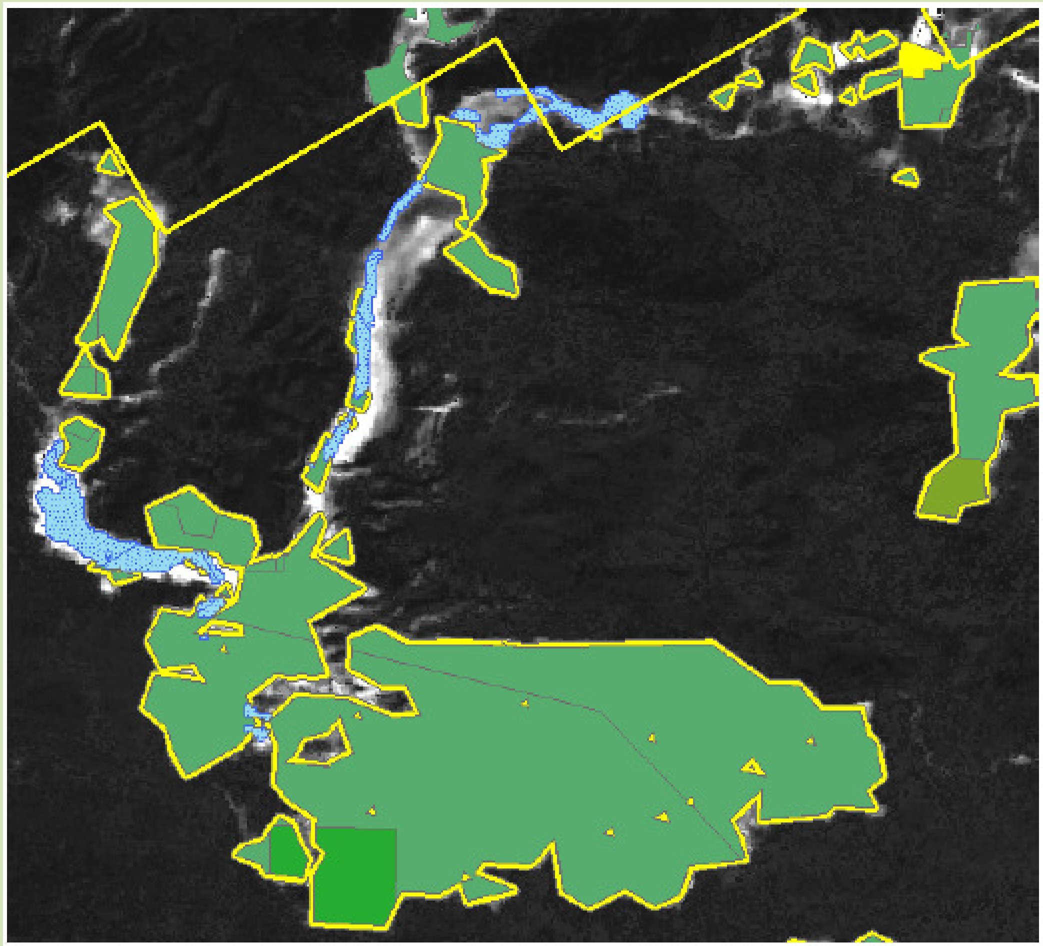
- The point of the adjustment factor is to modify the value of an estimate to more closely approximate the underlying true value.
- Adjustment factor = (TRUE VALUE)/(ESTIMATE)
- If we had enough data to calculate the TRUE VALUE , we wouldn't need the above equation. Unfortunately, data limits us to the above equation.
- For each entity, the final adjustment factors will be the product of the preliminary entity-by-entity factor and global coefficient.

Irrigated Lands Year 2000



The shades of green represent the irrigated lands for year 2000 and the blue areas represent wetlands. The white areas are areas of high ET outside the irrigated lands.

Irrigated Lands Year 2000 with Buffer



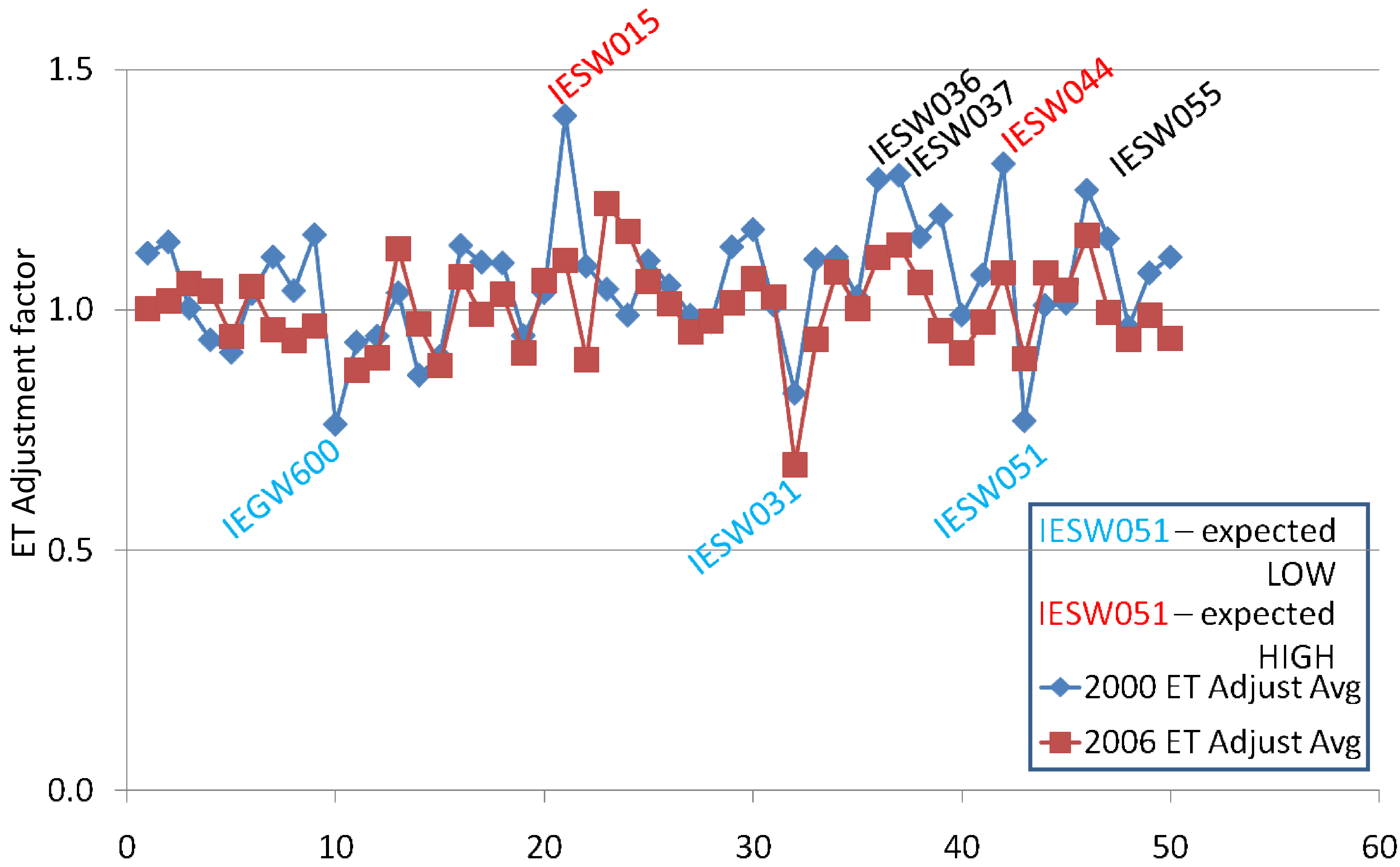
Using the ET from the irrigated lands and the buffers we were able to calculate an ET adjustment factor

The yellow represents the 70-meter buffer applied to the irrigated lands to encompass the high ET outside the irrigated lands.

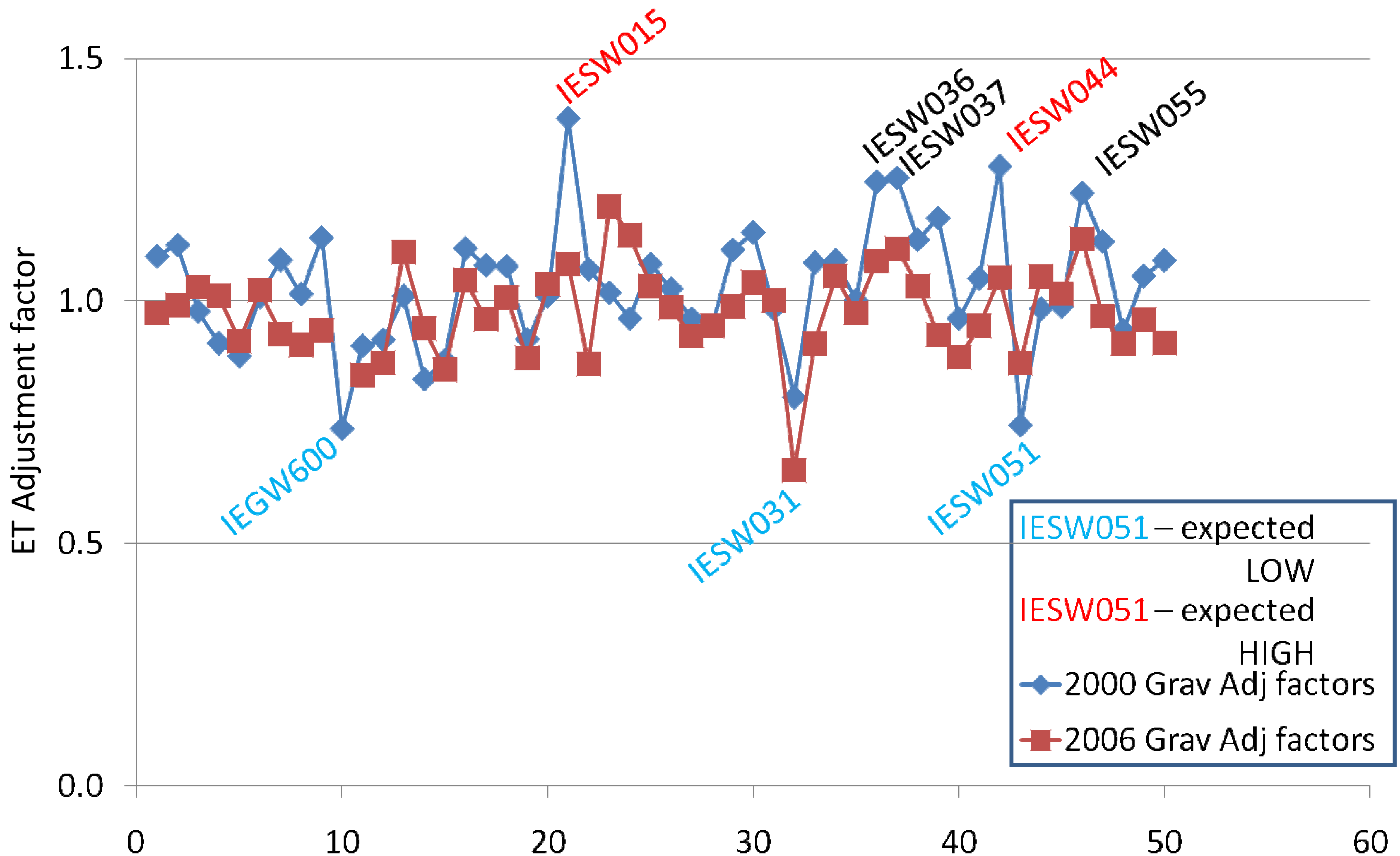
Available Data

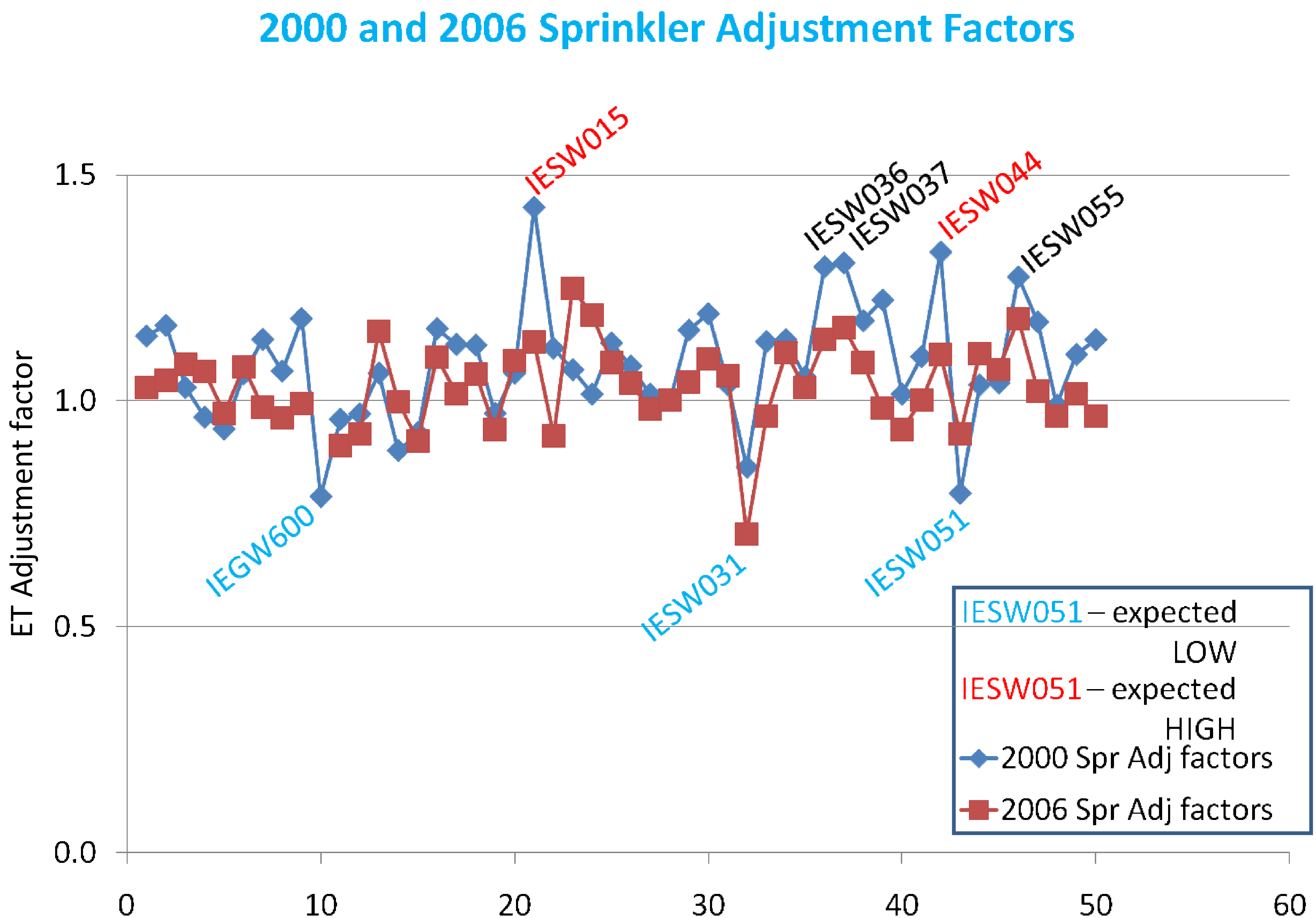
- 2000 METRIC ET and 2000 irrigated lands shapefile
- 2006 METRIC ET and 2006 irrigated lands shapefile

Comparing ET Adjustment Factors (Average of Sprinkler ET Adjust and Gravity ET Adjust)



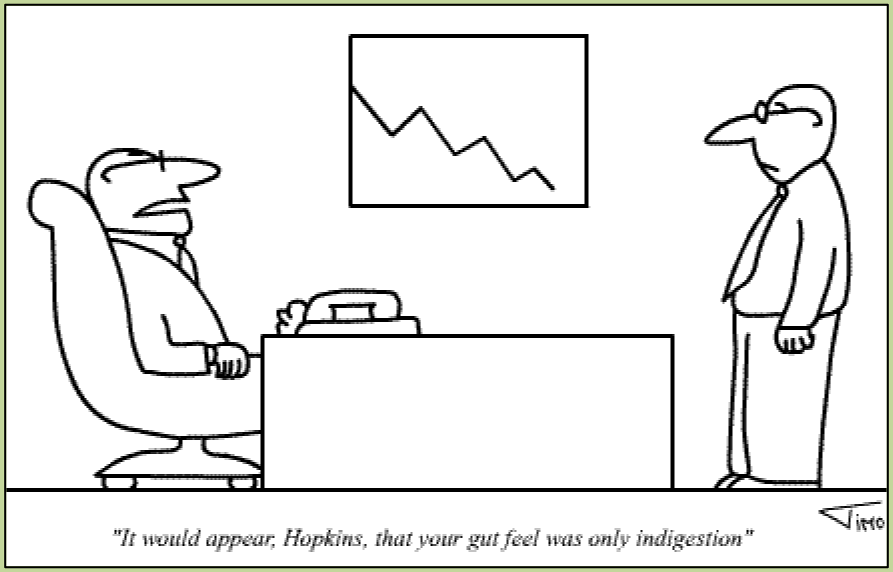
2000 and 2006 Gravity Adjustment Factors




2000 and 2006 Sprinkler Adjustment Factors
ET Adjustment factor
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
IESW015
IESW036
IESW037
IESW044
IESW055
IEGW600
IESW031
IESW051
IESW051 – expected LOW
IESW051 – expected HIGH
2000 Spr Adj factors
2006 Spr Adj factors

Decisions, Decisions

1. Pick one year of ET Adjustment factors (2000 or 2006) that may more accurately represent the entire calibration period 1980-2008
2. Take an average between the 2 years



3. Use both values, for example, use the 2000 ET adj factors for 1980-2003 and then 2006 ET adj factors for 2004-2008
   - ❖ This is a bit tricky using 2 values because only 1 is allowed; however, we can do some manual adjusting to make this work

Additional Equations

Calculation of the preliminary adjustment factor "A" for each entity was based on Equation (4):

$$\Sigma\,(A - 0.025)\,(1\text{-}SPR)\,X + \Sigma\,(A + 0.025)\,(SPR)\,X = \Sigma\,X_{METRIC} \qquad (4)$$

A	= preliminary adjustment factor for entity
X	= traditional ET volume for entity
X_{METRIC}	= METRCI ET volume for entity

All summations are across all polygons for the given entity

Calculation of traditional ET volume X is performed for each GIS polygon as follows:

$$X = (Area)\,(1\text{-}RED)\,(SrcFrac)\,(ET_{trad}) \qquad (5)$$

SrcFrac	= Fraction of supply that comes from the water source for the given polygon. For single-source parcels this value is 1.00. For mixed-source parcels, the source fraction for the groundwater polygon and the source fraction for the surface-water polygon sum to 1.00.

Additional Equations

Calculation of METRIC ET volume X_{METRIC} is performed for each GIS polygon as follows:

$$X_{METRIC} = (\text{Area})\ (\text{SrcFrac})\ (ET_{METRIC}) \tag{6}$$

ET_{METRIC} = GIS average depth of METRIC ET raster across irrigated polygon. Where a polygon intersects both the LANDSAT Path 39 raster and the LANDSAT Path 40 raster, we selected the greater ET depth. This is because the rasters are populated with a value of zero in the margins of the image. Parcels that straddle the boundary of lands actually represented will have low average values because they include regions of artificial zero values from the image margins.

Additional Equations

For the global coefficient C, conceptual Equation (2) can be specifically embodied by Equation (6):

$$C\,[\,\Sigma\,(A - 0.025)\,(1\text{-}SPR)\,X + \Sigma\,(A + 0.025)\,(SPR)\,X\,] + \Sigma Y = \Sigma\,X_{METRIC} + \Sigma\,Y_{METRIC} \qquad (6)$$

C	= Global coefficient
Y	= Expected volume of ET on 70-meter buffer around irriga Lands, if no runoff, overspray or other edge effects were present
Y_{METRIC}	= METRIC ET volume of ET on 70-meter buffer, including all runoff, overspray and other edge effects.

For each polygon in the 70-meter buffer, the value Y is calculated as:

$$Y = (Area_{buff})\,(ET_{NIR\text{-}SOIL}) \qquad (7)$$

$Area_{buff}$	= GIS area of individual polygon in buffer
$ET_{NIR\text{-}SOIL}$	= ET depth expected for given soil type, if no edge effects were present.

Additional Equations

The value Y_{METRIC} is:

$$Y_{METRIC} = (Area_{buff})\ (ET_{METRIC}) \tag{8}$$

To obtain a specific realization of conceptual Equation (3) for calculation of (C), Equation (6) was solved to yield Equation (9):

$$C = (\Sigma X_{metric} - \Sigma Y_{metric})/[(\Sigma(A - 0.025)(1 - SPR)X + \Sigma(A+0.025)(SPR)X] \tag{9}$$

For each entity, the final adjustment factors were calculated as follows:

$$ADJ_{spr} = (A + 0.025)\ C \tag{10}$$

$$ADJ_{grav} = (A - 0.025)\ C \tag{11}$$